Effect of Surface Additives and Overdrying on Cracking

Project 1108-29

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THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

EFFECT OF SURFACE ADDITIVES AND OVERDRYING ON CRACKING

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Report Nine

A Preliminary Report

to

TECHNICAL DIVISION
FOURDRINIER KRAFT BOARD INSTITUTE, INC.

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SUMMARY

A limited investigation of the effects of two surface additives and of overdrying on the cracking potential of 90-lb. linerboard has been carried out as part of a study of the effects of various factors on board cracking.

As expected, a surface treatment of starch increased bonding strength and other properties, but lowered the cracking angle. Thus, a surface starch application resulted in an increased tendency to crack. It was hoped that surface treatment with a debonding agent would decrease the tendency to crack without materially lowering other properties. In these trials 0.5 and 2-1/2% additions of Hyamine had little or no effect on the liner cracking angle.

When 90-lb. board was dried to a low moisture content and then reconditioned, a substantial decrease in the cracking angle was obtained. Thus, the tendency to crack should be much greater after severe drying treatments. This is in agreement with earlier results involving prolonged heating at high temperatures.

INTRODUCTION

Past work has been directed primarily toward the development of a test device for evaluating the cracking characteristics of kraft liner. The development of the tester and a qualitative analysis of the strains developed in linerboard during folding is reviewed in Report Six. Later reports have been concerned with the development of better coating procedures to facilitate detection of cracking.

As another phase of the work, a limited study has been underway to develop information regarding the effect of various board manufacturing variables on cracking. The objective here would be to determine ways of modifying board so as to reduce cracking.

Based on present understanding of the folding phenomena, it appears that cracking will be reduced if the stretch on the outer board layers is increased. For example, board laminated with a high stretch outer facing was shown in early work to have superior characteristics. Surface applications which improve bonding seem to have an adverse effect on cracking for this reason. Other factors which should affect cracking are shear strength, ply bonding thickness, type of fiber, refining, etc. For example, in Report Seven a number of board samples made with low and high hardwood contents and made available by the Union Bag-Camp Paper Corporation were evaluated. As expected, high hardwood contents resulted in lower cracking angles and higher combined board cracking.

It was hoped that the Institute web former could be used to produce experimental sheets under a wide variety of conditions. Preliminary trials indicated, however, that satisfactory sheets in the heavier weights could not be produced.

Therefore, as an alternative it was decided to study the effects of overdrying and surface additives on commercial board. To study the effect of overdrying, a roll of 90-lb. kraft linerboard was fed through the Institute's coater. The effects of surface applications of starch and Hyamine were studied using the same linerboard sample.

PROCEDURES

DRYING

In this phase the board was fed through the drying section of the coater at a speed of 13-1/2 feet per min. The air driers were controlled at 400°F. For a control, board was fed through the machine with the driers off. The moisture content of the dried material was 0.65%.

SURFACE APPLICATIONS

A small laboratory size press was used to obtain 0.5 and 2-1/2% pick-ups of Hyamine 1622 – a debonding agent. Solution concentrations of 5 and 10% were used and 2 passes at 15 p.s.i. pressure were made.

The same press was used to obtain 1 and 2% pick-ups of starch (Superfilm 40).

Control samples were taken using 1 pass with no coating and 1 pass with plain water.

The materials were drum dried after coating.

TESTING

All materials were conditioned at 20% R.H. and 73°F. and all testing was carried out in this atmosphere.

DISCUSSION OF RESULTS

The results obtained are summarized in Table I. As would be expected, overdrying lowered the cracking angle substantially. Thus, it would be anticipated that the overdried board would exhibit greater cracking when used as a double-face liner on corrugated board. With regard to other properties the dried material exhibited somewhat higher ring compression tensile and IGT bonding strength.

Hyamine normally acts as a debonding agent. It was thought a light surface application to the board would reduce the bonding in the surface layers. This would result in better cracking performance without any major change in other properties. In this case, however, little or no change in cracking angle occurred. The Hyamine did reduce bonding strength slightly and increase stretch. Some improvement in the liner cracking angle would have been expected under these circumstances.

Lower cracking angles tended to be obtained when starch was used as a surface treatment. Thus, more combined board cracking would be expected. The starch treatment increased bonding strength, tensile, and ring compression as would be expected.

TABLE I

EFFECT OF DRYING AND SURFACE ADDITIVES ON LINER CRACKING AND OTHER CHARACTERISTICS

Treatment	Cracking Angle, degree	Moisture Content, %	Weight, lb./M ft.^{2}	Caliper, pt.	IGT Bonding Strength, kp. cm./sec.	Tensile M.D.	lb./in. C.D.	Stretch, % M.D.	Stretch, % C.D.	Modified Ring Compression, lb./in.
Drying Study										
Control	49.2	4.8	88.1	23.7	117	159.6	82.2	1.6	2.8	36.7
Dried	43.4	3.5	87.8	23.4	126	174.5	84.6	1.5	2.4	38.7
Surface Application										
Control – dry	46.3	--	88.6	23.4	107	161.7	79.3	1.4	2.5	36.5
Control – water	45.0	--	87.3	23.6	123	159.8	81.4	1.4	2.6	35.1
0.5% Hyamine	46.9	--	88.1	25.1	91	160.9	81.3	1.6	2.6	36.3
2-1/2% Hyamine	44.3	--	89.9	25.5	97	157.0	81.8	1.6	3.0	36.3
1% Starch	44.4	--	88.7	24.3	184	174.0	85.8	1.6	2.7	39.4
2% Starch	42.8	--	89.6	24.0	258	176.4	89.0	1.6	2.7	40.4

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